

First Russian records of *Stemonitis rhizoideipes* and *Fuligo aurea*, and newly observed morphology for *Comatricha anomala*

ANASTASIA V. VLASENKO^{1*}, NINA V. FILIPPOVA²,
VYACHESLAV A. VLASENKO¹

¹ Laboratory of Mycology, Algology and Lichenology, Central Siberian Botanical Garden,
Siberian Branch, Russian Academy of Sciences, Novosibirsk, 630090, Russia

² Yugra State University, Khanty-Mansiysk, 628012, Russia

* CORRESPONDENCE TO: anastasiamix81@mail.ru

ABSTRACT—Three rare species of myxomycetes have been collected from Khanty-Mansi Autonomous Okrug–Yugra, Russia. *Stemonitis rhizoideipes* and *Fuligo aurea* were recorded for the first time in Russia and for the second time in extratropical Eurasia, and *Comatricha anomala* was recorded from a second Russian location. Thirty-three *S. rhizoideipes* specimens were isolated from bark of *Abies sibirica*, *Picea obovata*, and *Pinus sibirica* in moist chambers, while *F. aurea* plasmodiocarps were retrieved from *A. sibirica* bark in one Petri dish. We publish an emended description of *Comatricha anomala* after discovering new morphological features. Light and scanning electron micrographs and comparisons with morphologically similar taxa are presented for the three species.

KEY WORDS—*Myxogastria*, *Physaraceae*, SEM, *Stemonitidaceae*

Introduction

Myxomycetes are protists usually present in terrestrial ecosystems and constitute a well-defined and homogenous group of approximately 1000 species (Lado 2021). Large fruiting myxomycete bodies (known as sporocarps) can be collected in the field. The moist chamber culture technique, widely used to study myxomycete species with small fruiting bodies, is a highly efficient technique to reveal hidden diversity of epiphytic myxomycetes (Gilbert & Martin 1933, Härkönen 1977, Vlasenko & Vlasenko 2020).

Two rare myxomycete species, *Stemonitis rhizoideipes* and *Fuligo aurea*, have been recorded for the first time in Russia, and *Comatricha anomala* has been recorded from a second Russian location. All three species are described below.

Materials & methods

Specimens and samples were collected from two sites in the Khanty-Mansiysky district of Khanty-Mansi Autonomous Okrug–Yugra: (1) 22 km north-east of Khanty-Mansiysk, near Shapsha settlement; (2) 22 km south-west of Khanty-Mansiysk, near the Mukhrino Field Station of Ugra State University. Microscopical observations were made using a Stemi DV4 stereomicroscope, Axiolab E-re, and Zeiss Axio Imager A1 light microscopes, and a Carl Zeiss EVO MA 10 scanning electron microscope. Descriptions use the abbreviations TL = transmitted light and RL = reflected light. Specimens were conserved in the MG Popov Herbarium, Central Siberian Botanical Garden, Siberian Branch of Russian Academy of Sciences, Novosibirsk, Russia (NSK).

Taxonomy

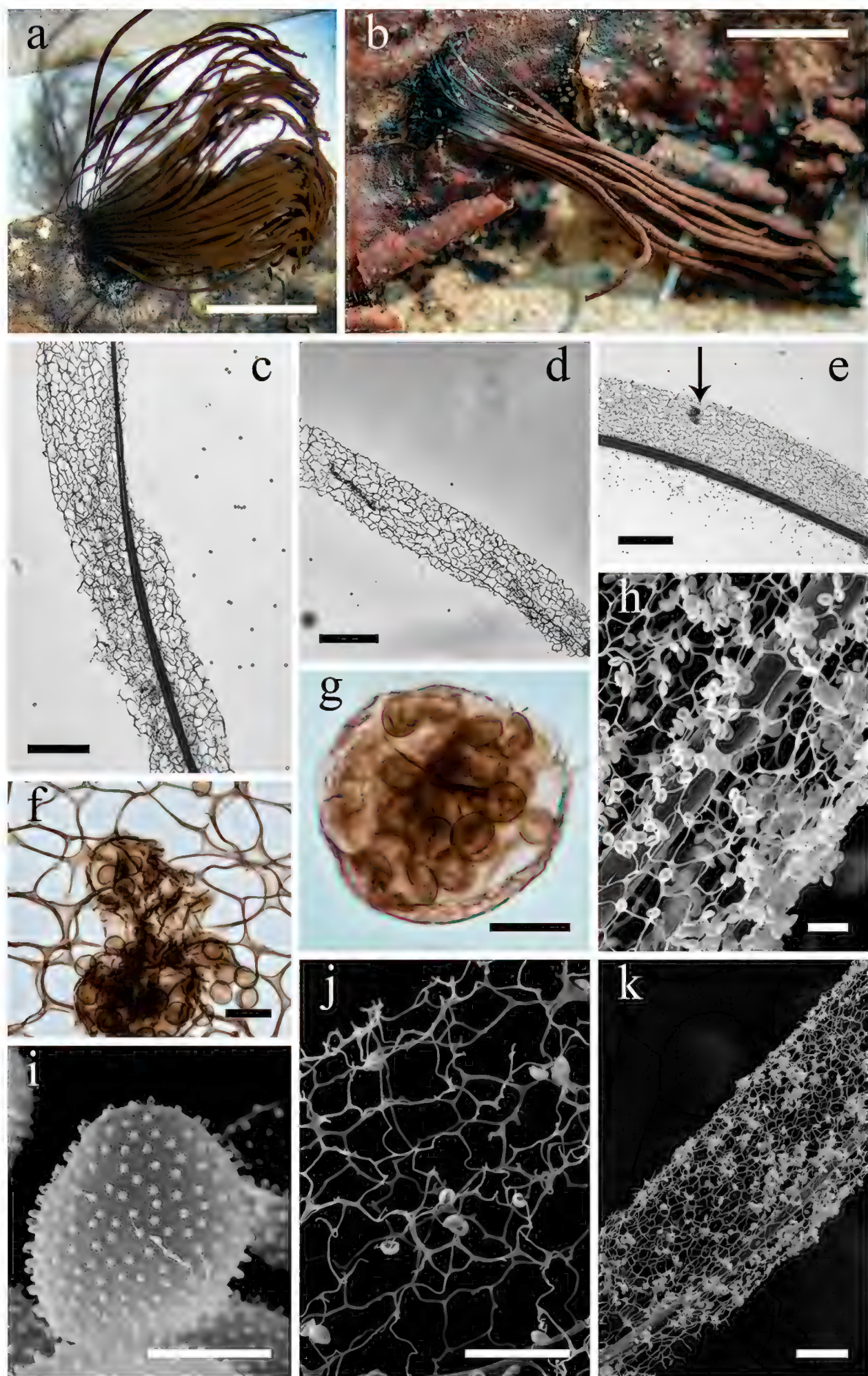
Stemonitis rhizoideipes Nann.-Bremek., R. Sharma & K.S. Thind,

Proc. K. Ned. Akad. Wet., Ser. C, Biol. Med. Sci. 87(4): 465 (1984)

FIG. 1

SPOROCARPS tufted, cylindrical, always bent or recumbent, 15–25 mm tall overall, brown. SPOROTHECA long cylindrical, 10–20 × 0.5–0.7 mm. HYPOTHALLUS often in tufts, red-brown, shiny with rhizoid-like thickenings where merging with stalk. STALK short, black in RL, brown or red-brown in TL, 1–5 mm long, merging with hypothallus by rhizoid-like strands. PERIDIUM fugacious except for some smooth, rounded or oval flakes that cling to surface but not attached to capillitium; shiny brown in RL, transparent pale brown in TL. COLUMELLA always dispersing into capillaries before reaching the apex. CAPILLITIUM brown, forming a lax net around columella, axils with membrane expansions, meshes irregular, 30–275 µm diam., free ends forming short spikes; capillitial net connected to columella only at the base and (rarely) at the apex; elsewhere the capillitium is free and not attached to columella, enabling the net of capillitial threads to move freely without damaging the columella. SPORE MASS brown. SPORES pale brown, globose, warted, 8–10 µm diam; in SEM spore ornamentation comprising regularly distributed warts with dense or delicate reticulum sometimes forming between warts.

FIG. 1. *Stemonitis rhizoideipes* (NSK 1030488): a, b. Sporangia (RL); c, d. Capillitium (TL); e. Capillitium, arrow indicates the peridial remnants (TL); f. peridial remnants, spores (TL); g. Capillitium, peridial remnants, spores (TL); h. Capillitium, spores (SEM); i. Spore (SEM); j. Capillitium at the sporotheca apex, spores (SEM); k. Capillitium, spores (SEM). Scale bars: a, b = 5 mm; c–e = 200 µm; f, g = 20 µm; h = 30 µm; i = 5 µm; j, k = 100 µm.



SPECIMENS EXAMINED: RUSSIAN FEDERATION, KHANTY-MANSI AUTONOMOUS OKRUG–YUGRA, Khanty-Mansiysky district, 22 km north-east of Khanty-Mansiysk, near Shapsha settlement, 61.0808°N 69.4519°E, 43 m, old-aged coniferous mixed forest, on bark of living *Picea obovata*, substrate samples collected 27 September 2017, N.V. Filippova, moist chamber culture 05 January 2018, cult. and ident. A.V. Vlasenko (NSK 1030488); 61.0664°N 69.4689°E, 40 m, secondary deciduous forest, on bark of living *Abies sibirica*, substrate samples collected 28 September 2017, N.V. Filippova, moist chamber culture 31 January 2018, cult. and ident. A.V. Vlasenko (NSK 1030351); on bark of living *Picea obovata*, substrate samples collected 28 September 2017, N.V. Filippova, moist chamber culture 10 March 2019, cult. and ident. A.V. Vlasenko (NSK 1030493); 22 km south-west of Khanty-Mansiysk, near the Mukhrino Field Station of Ugra State University, old-aged coniferous mixed forest, 60.8906°N 68.7031°E, 37 m, on bark of living *Picea obovata*, substrate samples collected 19 October 2017, N.V. Filippova, moist chamber culture 10 March 2019, cult. and ident. A.V. Vlasenko (NSK 1030372); on bark of living *Abies sibirica*, substrate samples collected 19 October 2017, N.V. Filippova, moist chamber culture 22 March 2019, cult. and ident. A.V. Vlasenko (NSK 1030530).

ECOLOGY & DISTRIBUTION: Epiphytic on bark of living trees. Previously known from Europe (France), Asia (Bhutan, India, Indonesia), and Australasia (New Zealand) (Nannenga-Bremekamp 1984, GBIF on-line 1) with fewer than ten records worldwide. This represents a first record for Russia.

COMMENTS: *Stemonitis rhizoideipes* sporocarps were retrieved from 33 Petri dishes. This species is distinguished from others in *Stemonitidaceae* by its very thin long isolated and unconnected sporangia and rounded peridial remnants (also found in *Symphitocarpus*). Our SEM study of *S. rhizoideipes* morphology did not reveal any differences from the original description. SEM photos of *S. rhizoideipes* microstructures were obtained here for the first time.

Fuligo aurea (Penz.) Y. Yamam., Myxomyc. Biota Japan: 390 (1998)

FIG. 2

PLASMODIOCARPS sessile, branched, often merging together, sometimes remaining individual, yellow, grey-yellow, or almost white with yellow speckles. PERIDIUM single, pale yellow to whitish yellow, bearing deposits of yellow or ochraceous lime. STALKS, when present, yellow, filiform, merging with hypothallus strands. COLUMELLA absent. CAPILLITIUM elastic,

FIG. 2. *Fuligo aurea* (NSK 1030738): a, b. Plasmodiocarps (RL); c. Plasmodium (RL); d–f. Macrocyts at different stages of maturation (RL); g. Capillitium, spores (SEM); h. Spore (SEM); i. Spore surface ornamentation (SEM); j. Calcium granules from the nodes of capillitium (SEM). Scale bars: a = 1 mm; b = 0.5 mm; c = 0.5 cm; d, e = 0.5 mm; f = 0.2 mm; g = 10 µm; h = 2 µm; i = 1 µm; j = 5 µm.



composed of a persistent net of colourless tubules; capillitial junctions mostly limeless but bearing a few yellow fusiform calcareous nodes. SPORE MASS black or brownish black. SPORES pale violaceous brown, minutely punctate, 7–8 μm diam. PLASMIDIUM yellow; macrocysts orange.

SPECIMEN EXAMINED: RUSSIAN FEDERATION, KHANTY-MANSI AUTONOMOUS OKRUG–YUGRA, Khanty-Mansiysky district, 22 km north-east of Khanty-Mansiysk, near Shapsha settlement, 61.0664°N 69.4689°E, 40 m, secondary deciduous forest, on bark of living *Abies sibirica*, substrate samples collected 28 September 2017, N.V. Filippova, moist chamber culture 04 March 2018, cult. and ident. A.V. Vlasenko (NSK 1030738).

ECOLOGY & DISTRIBUTION: Lignicolous on dead wood of deciduous and coniferous trees. We isolated *Fuligo aurea* from the bark of a living tree as an epiphyte for the first time. Distributed in Europe (Sweden), Asia (Japan, Taiwan, Thailand, Philippines, Indonesia, Malaysia, India), Australasia (Australia, New Zealand), Africa (Reunion), North America (Mexico), and South America (Venezuela) (Yamamoto 1998, Stephenson 2003, Kylin & al. 2013, Liu & Chang 2012, Dagamac & dela Cruz 2015, GBIF on-line 2, GBIF on-line 3). This represents a first record for Russia.

COMMENTS: Sporocarps of *Fuligo aurea* were retrieved from one Petri dish. The specimen appeared after 1.5 years of cultivation in a moist chamber. Observations of the large yellow *F. aurea* plasmodium over a lengthy period revealed that two months after initiating cultivation, macrocysts several times appeared for short periods before transforming back into the plasmodial stage. These macrocysts, which were bright, yellow-orange, 0.2–1 cm diam., were observed in five moist chambers. Plasmodia transformed into plasmodiocarps in only one moist chamber. As myxomycetes growing in moist chambers may differ morphologically from samples collected in the field (Haskins & Wrigley de Basanta 2008), we publish a revised description for *F. aurea* based on newly observed morphological features. In some specimens, peridium had not only yellow colouration, but also greyish yellow. *Fuligo aurea* and *Physarum gyrosum* Rostaf. both develop sessile sporocarps with a grey peridium that are branched and often merge together, but the structure of the capillitial calcareous nodes distinguish the two species: those in *Ph. gyrosum* are white and tough, contrasting with the yellow nodes that expand to several times their original size upon the disintegration of the peridium. We are the first to record and describe macrocysts in *F. aurea*.

Comatricha anomala Rammeloo,

Bull. Jard. Bot. Univers. Belgrade 46: 237. (1976)

FIG. 3

SPOROCARPS in groups on a common hypothallus; typically 1.5–2.5 mm tall overall in which the sporotheca is cylindrical with a rounded wider base and rounded narrower top, dark brown, and with a stalk 25–50% of total height; more rarely small the sporocarp is smaller (≤ 0.7 mm tall overall) and the sporotheca spherical with stalk 50–75% of total height; for both sizes STALK not hollow, fibrous, black (almost opaque in TL), rarely reddish-brown at the base. HYPOTHALLUS is common to each group, clearly visible, membranous, dark brown, meshed or folded, shiny at the stalk base, yellowish-brown in TL, with appendages in the form of stretched ropes. COLUMELLA a continuation of the stalk inside the sporangia, opaque, pointed at the top, not reaching the sporothecal tip but splitting at the apex into two or three main capillitial branches. PERIDIUM rapidly disintegrating, not preserved after maturation. CAPILLITIUM dense and brown, forming a large-mesh surface net, which protrudes into smaller individual meshes (≤ 5 μm diam.) on the periphery; capillitium containing many free ends ≤ 15 – 35 μm long. SPORE MASS brown. SPORES globose, light greyish brown in TL, 7.5–9 μm diam., ornamented with warts, some forming 3–4 small incomplete reticulations on spores with small meshes. PLASMIDIUM not observed.

SPECIMENS EXAMINED: RUSSIAN FEDERATION, KHANTY-MANSI AUTONOMOUS OKRUG–YUGRA, Khanty-Mansiysky district, 22 km north-east of Khanty-Mansiysk, near Shapsha settlement, Elevated bog “Chistoe”, 61.0669°N 69.4567°E, 36 m, forested bog community with dominant *Pinus sylvestris* and cover of dwarf shrubs and *Sphagnum*, on bark of living *Pinus sylvestris*, substrate samples collected 01 October 2017, N.V. Filippova, moist chamber culture 04 March 2018, cult. and ident. A.V. Vlasenko (NSK 1030750); 22 km south-west of Khanty-Mansiysk, near the Mukhrino Field Station of Ugra State University, elevated bog “Mukhrino”, 60.8947°N 68.6831°E, 40 m, forested bog community with dominant *Pinus sylvestris* and cover of dwarf shrubs and *Sphagnum*, on bark of living *Pinus sylvestris*, substrate samples collected 13 October 2017, N.V. Filippova, moist chamber culture 04 May 2018, cult. and ident. A.V. Vlasenko (NSK 1030746).

ECOLOGY & DISTRIBUTION: Epiphytic on bark of living trees. Distributed in Europe (Austria, Belgium, France, Germany, Italy, Norway, Malta, Portugal, Spain), Asia (Russian Federation [Novosibirsk Region]), and North America (USA, Mexico, Cuba) (Rammeloo 1976, Johannesen 1984, Kowalski & Demaree 1987, Moreno & al. 1992, Lizárraga & al. 1997, Briffa & al. 2000, Neubert & al. 2000, Camino & al. 2008, Vlasenko & Vlasenko 2020, GBIF

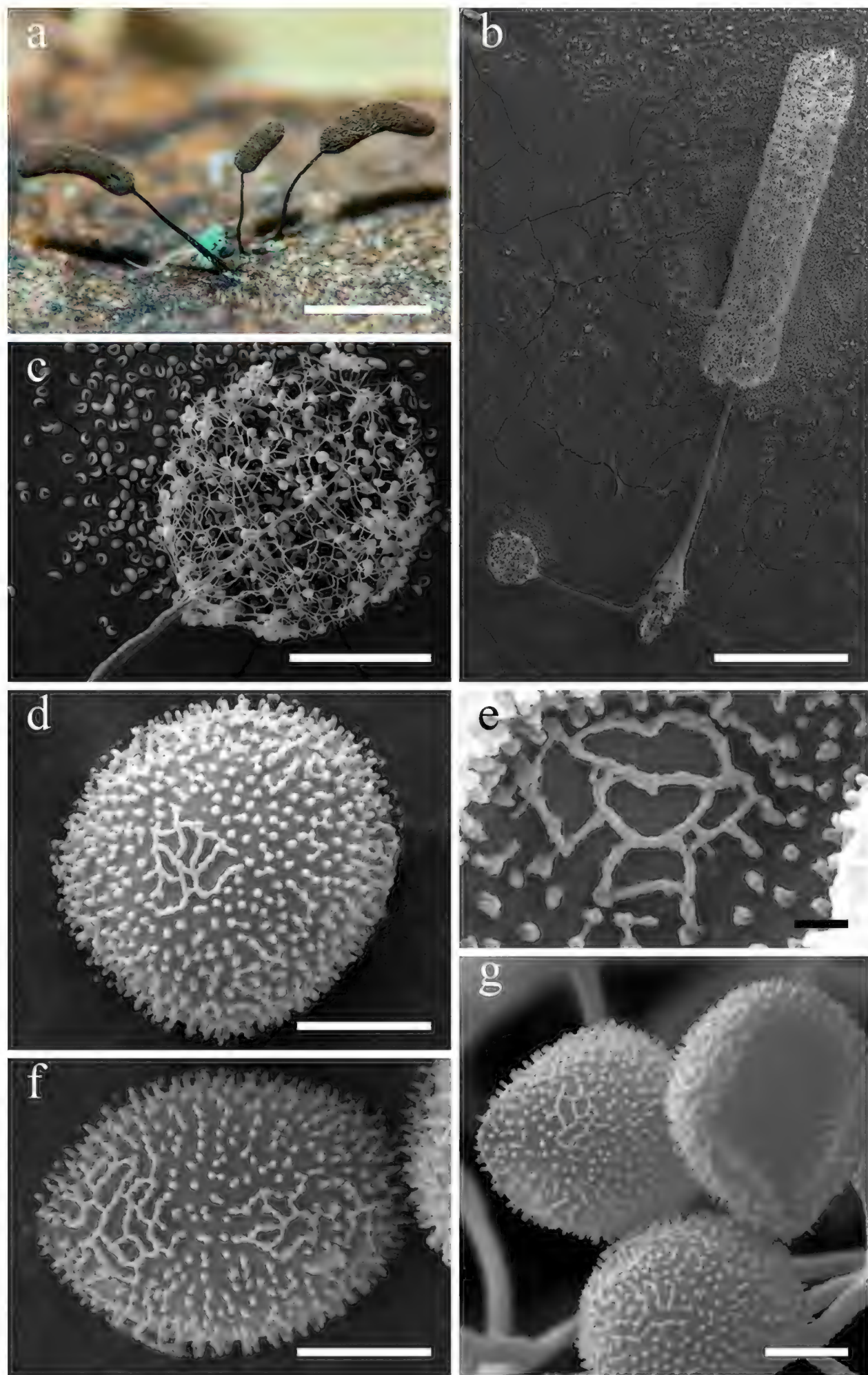


FIG. 3. *Comatricha anomala* (NSK 1030750): a. Sporocarps with typical cylindrical sporotheca (RL); b. Sporocarp with typically cylindrical large sporotheca and sporocarp with atypically spherical small sporotheca (SEM); c. Small spherical sporotheca with capillitium and spores (SEM); d. Spore (SEM); e. Spore surface ornamentation (SEM); f. Spore (SEM); g. Spores and capillitium (SEM). (NSK 1030741):. Scale bars: a = 1.5 mm; b = 500 µm; c = 100 µm; d = 3 µm; e = 500 nm; f, g = 3 µm.

on-line 4). This is the second record of *Comatricha anomala* in Russia; previously recorded in the Novosibirsk Region (Vlasenko & Vlasenko 2020).

COMMENTS: *Comatricha anomala* sporocarps retrieved from three Petri dishes enabled us to identify some new morphological features not included in Rammeloo's type description. Here, atypical *C. anomala* sporocarps producing spherical sporotheca were identified for the first time. Spore size and ornamentation in samples with spherical and cylindrical sporotheca are completely identical, and both typical and atypical sporocarps were derived from the same plasmodial group. The sporocarps producing spherical sporotheca might be confused with sporocarps of *C. laxa* Rostaf., also characterized by spherical sporotheca. *Comatricha anomala* and *C. laxa* can be distinguished only by spore ornamentation as seen under SEM, making SEM essential for species identification. Spores of *Comatricha laxa* are ornamented with warts, while those of *Comatricha anomala* produce some that form small incomplete reticulations with small meshes.

Acknowledgments

The research of V.A. Vlasenko and A.V. Vlasenko was carried out as a part of the State Task for the Central Siberian Botanical Garden, the Siberian Branch of the Russian Academy of Sciences, project AAAA-A21-121011290024-5. Herbarium specimens were deposited into MG Popov Herbarium (NSK), USU 440537, Novosibirsk. The authors thank Daria Erastova (The University of Auckland, New Zealand) and Yang Gao (Jiangxi Agricultural University, Nanchang, China) for presubmission review.

Literature cited

- Briffa M, Moreno G, Illana C. 2000. Some rare myxomycetes from Malta. *Stapfia* 73: 151–158.
- Camino M, Moreno G, Castillo A, Mitchell DW, Minter DW. 2008. Additions to the myxomycete biota of Cuba. 1. *Mycotaxon* 106: 75–102.
- Dagamac NHA, dela Cruz TEE. 2015. Myxomycetes research in the Philippines: updates and opportunities. *Mycosphere* 6(6): 784–795. <https://doi.org/10.5943/mycosphere/6/6/12>
- GBIF (on-line 1): *Stemonitis rhizoideipes* Nann.-Bremek., R. Sharma & K.S. Thind. – GBIF Secretariat, Copenhagen. Accessed 28 May 2022: <https://www.gbif.org/ru/species/5425744>
- GBIF (on-line 2): *Fuligo aurea* (Penz.) Y. Yamam. – GBIF Secretariat, Copenhagen. Accessed 28 May 2022: <https://www.gbif.org/ru/species/5426025>

- GBIF (on-line 3): *Erionema aureum* Penz. – GBIF Secretariat, Copenhagen. Accessed 28 May 2022: <https://www.gbif.org/ru/species/5426026>
- GBIF (on-line 4): *Comatricha anomala* Rammeloo – GBIF Secretariat, Copenhagen. <https://www.gbif.org/ru/species/3213106> [accessed 28 May 2022]
- Gilbert HC, Martin GW. 1933. Myxomycetes found on the bark of living trees. University of Iowa Studies in Natural History 15: 3–8.
- Härkönen M. 1977. Corticolous myxomycetes in three different habitats in southern Finland. Karstenia 17: 19–32. <https://doi.org/10.29203/ka.1977.121>
- Haskins EF, Wrigley de Basanta D. 2008. Methods of agar culture of myxomycetes—an overview. Revista Mexicana de Micología 27: 1–7.
- Johannesen E. 1984. New and interesting myxomycetes from Norway. Nordic Journal of Botany 4: 513–520. <https://doi.org/10.1111/j.1756-1051.1984.tb02057.x>
- Kowalski DT, Demaree RS. 1987. *Comatricha anomala*, a new record for the western hemisphere. Mycologia 79(1): 140–141. <https://doi.org/10.1080/00275514.1987.12025380>
- Kylin H, Mitchell DW, Seraoui EH, Buyck B. 2013. Myxomycetes from Papua New Guinea and New Caledonia. Fungal Diversity 59: 33–44. <https://doi.org/10.1007/s13225-012-0180-y>
- Lado C. 2021. An on line nomenclatural information system of *Eumycetozoa*. Real Jardín Botánico, CSIC. Madrid, Spain. <http://www.nomen.eumycetozoa.com/data/index.php> [accessed April 2021].
- Liu CH, Chang JH. 2012. Six genera of *Physaraceae* (*Myxomycetes*) in Taiwan. Taiwania 57(3): 263–270.
- Lizárraga M, Moreno G, Illana C. 1997. The myxomycetes from Baja California (Mexico). I. Mycotaxon 63: 287–300.
- Moreno G, Illana C, Heykoop M. 1992. Spanish myxomycetes. VI. Four interesting species belonging to *Stemonitales*. Cryptogamie, Mycologie 13: 295–303.
- Nannenga-Bremekamp NE, Yamamoto Y, Sharma R. 1984. *Stemonaria*, a new genus in the *Stemonitaceae* and two new species of *Stemonitis* (myxomycetes). Proceedings van de Koninklijke Nederlandse Akademie van Wetenschappen Section C. 87: 449–469.
- Neubert H, Nowotny W, Baumann K, Marx H. 2000. Die Myxomyceten Deutschlands und des angrenzenden Alpenraumes unter besonderer Berücksichtigung Österreichs. Band 3: *Stemonitales*. Karlheinz Baumann Verlag, Gomaringen.
- Rammeloo J. 1976. *Comatricha anomala*, a new myxomycete from Belgium. Bulletin du Jardin Botanique National de Belgique 46: 237–240. <https://doi.org/10.2307/3667418>
- Stephenson SL. 2003. Myxomycetes of New Zealand. Fungi of New Zealand/Ngā Harore o Aotearoa, vol. 3. Fungal Diversity Research Series 11. 238 p.
- Vlasenko A, Vlasenko V. 2020. First Asian record of *Comatricha anomala*, a rare epiphytic corticolous myxomycete. Karstenia 58(1): 10–15. <https://doi.org/10.29203/ka.2020.485>
- Yamamoto Y. 1998. The myxomycete biota of Japan. 700 p.